

A SUMMARY REPORT (1970 - 1971 - 1972) OF THE ABATEMENT OF ARSENIC  
CONTAMINATION IN THE MOIRA RIVER AT DELORO.

ONTARIO MINISTRY OF THE ENVIRONMENT. INDUSTRIAL WASTES BRANCH.  
JANUARY 1973.

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Environment Ontario

A

SUMMARY REPORT

(1970 - 1971 - 1972)

OF

THE ABATEMENT OF ARSENIC CONTAMINATION

IN THE MOIRA RIVER AT DELORO

JANUARY 1973

INDUSTRIAL WASTES BRANCH

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## SUMMARY

This report is intended to summarize and evaluate the work completed at the abandoned plant site of Deloro Smelting and Refining Company Limited during the past three years in the abatement of arsenic contamination in the Moira River.

Since the last report of April 1970, considerable effort has been expended by both the company and Ministry staff to correct this long standing problem.

Moira Lake, which has been the main area of concern, can be considered satisfactory as a source of drinking water for cottagers. It is thought that the remaining areas of concern at the former plant site can be easily resolved by the summer of 1973 and consequently the arsenic concentration in Moira Lake is expected to be lowered to within the drinking water quality criteria for continuous use of 0.05 ppm.

Investigations to locate other possible sources of ground-water contamination are continuing, and if detected, the company will be requested to take immediate corrective action.

As the present collection and treatment facilities will need to be maintained and operated for a considerable time in the future, it is strongly urged that the Company investigate methods by which the Deloro site may be stabilized more quickly.

BRIEF HISTORY OF EVENTS FOLLOWING CLOSURE OF THE DELORO PLANT

In 1961 Deloro Smelting and Refining Company Limited shut down operations at Deloro. At that time it was thought that, with a general cleanup of the plant site, the arsenic concentrations in the river would subside. Therefore, until 1965 this, along with the demolition of buildings, was the only work done at the site.

In a report on the situation in 1965 it was recommended that certain arsenic bearing surface waters be collected and treated for arsenic removal before being discharged to the river. It was also recommended that the calcium arsenite ponds and poison pond be covered with lime and slag. This work was completed and the treatment facilities made operational by the fall of 1966.

Although the report pointed out the locations of certain arsenic concentrates and made recommendations as to the collection and treatment of surface waters, it was not until the late 1960's that the problem was recognized as one dealing primarily with leaching by groundwater.

SUMMARY OF WORK COMPLETED AT DELORO SINCE JANUARY 1970

1970

Through exhaustive sampling programs and geological appraisals it was determined that the major portion of arsenic gaining access to

the river was being leached and conveyed via the groundwater. It was thought that the former poison pond and calcium arsenite ponds were the main sources of groundwater contamination. A study was initiated to determine how best these sources could be contained. The study entailed the digging of a series of observation holes and measuring the arsenic concentrations of the groundwater in the area surrounding these known sources in the north west sector of the former plant site.

As a temporary measure contaminated groundwater was pumped from the observation holes to the waste treatment facilities. To provide a more permanent solution work began in June 1970 on a plan to seal and underdrain this area. A trench was dug to bedrock on the west and south sides of the former poison pond. Groundwater collected in the trench was pumped to the treatment facilities, for removal of the arsenic. To enable the reader to gain a better understanding of the work conducted, a map of the plant site is included at the end of the report.

A Requirement and Direction was issued to the Company on July 17, 1970, under which the Company was required to:

- Construct facilities on or before August 31, 1970, including
  - (a) completion of work started in June.
  - (b) the repair of the tailings dam and the construction of a suitable decant structure for the impounded

materials on the east side of the Moira River.

- Make investigations and submit reports on methods of improving the treatment of arsenic bearing wastes.

Among the items the Company was asked to report on were enlargement of the existing settling ponds, the improvement of the precipitation of the arsenic and settling of the precipitate in the pond itself.

- Carry out a survey of the property to define other possible sources of arsenic and to report its findings to the Commission before November 30, 1970.
- Make investigations into methods by which the red mud tailings area may be stabilized.

In August, the company repaired leaks in the dam impounding the tailings on the east side of the river. Also, a decant structure was constructed in the repaired dam for the release of water impounded by the dam to Young's Creek.

In November 1970 the company completed the sealing and underdraining of the area of the former poison pond with the underdrainage being diverted to the treatment facilities via the New Westerly Creek. The entire area to the east of the calcium arsenite ponds was graded and capped with 18" of clay. At the same time the north settling pond was dredged and the solids were pumped to the red mud tailings area on

the east side of the river.

In a series of transactions during the latter part of 1970, the Deloro property was transferred to Ericksen Construction Company Limited, a subsidiary of M.J. O'Brien Limited.

In November the company submitted a report on other possible sources of arsenic contamination. However, as the report was considered to be inadequate, the Commission retained the firm of James F. MacLaren Limited, Consulting Engineers in December to prepare a report on the sources, movement and containment of arsenic contamination at the site.

### 1971

James F. MacLaren commenced their study in January 1971 at which time they collected samples at the site and reviewed data previously obtained by Commission staff and the Company. Because of heavy snow cover, the groundwater assessment work had to be delayed. However, an interim report on the work completed to that date was submitted.

The groundwater survey was conducted in April 1971 and a final report was submitted in mid-May. It was found in the survey that contaminated soil around the former arsenic packing shed was a further major source of arsenic gaining access to the river. It was recommended in the report that the contaminated groundwater be collected by means

of a tile drain leading to the treatment facilities.

Because the arsenic concentration in the wastes being treated had increased considerably with the collection of highly contaminated groundwater, lime addition facilities were installed at the treatment facilities in May 1971 to maintain a neutral pH and thus ensure maximum precipitation. In June the New Westerly Creek upstream of the contaminated area was diverted to greatly reduce the volume of water being treated. This modified system will in the future be referred to as the westerly collection system.

Following further investigative work by the Company, it was determined that the contaminated groundwater from the area of the former packing shed could not be transferred to the treatment facilities by a simple gravity drain since the volume was small and the topography of the bedrock uneven. In its place two clay dykes were installed, one about 150' in length located between the former packing shed and the river, and the other about 40' in length located under a wooden truss to the north west of the packing shed. Sumps were installed behind these dykes to collect the contaminated groundwater. This system, which will in the future be referred to as the clay dyke collection system was placed in operation in August 1971 with the collected groundwater being pumped via burried pipe to the improved treatment facilities.

In early fall 1971 while conducting a study to determine the

effectiveness of the work completed to that date, a further significant contaminated flow was detected. This consisted of groundwater seepage entering a small swampy area and drainage ditch located to the north of the former packing shed. Upon being informed of this source, the company installed, in late November 1971, another dyke and sump system to collect and transmit this contaminated seepage to the treatment facilities.

Other work done at the site in the fall of 1971 included:

- dredging of north settling pond
- repairing two minor leaks in the tailings dam
- stabilizing the river bank adjacent to the former packing shed.

#### 1972

Throughout 1972, in an effort to evaluate the work completed at the site in the previous two years, intensive sampling and flow measurement of the various groundwater streams were continued in addition to the regular monitoring of the river.

In June the Company retained the services of Erocon Limited to investigate revegetation of the red mud tailings area and in August stated that, because the site was to continue to be used for disposal of settling pond solids the company did not intend to revegetate at this

time.

Throughout November the company was at the site conducting the following work:

- leaks in the east and west tailings dam structures were repaired.
- the plastic pipe leading from the sump located in the upper swamp which had frozen the previous winter was burried at a sufficient depth to prevent a recurrence of freezing.
- the sequence of chemical addition was reversed so that lime was added after the addition of ferrous sulphate as was the original design.
- the precipitates contained in the north settling pond, which had built up to a point where virtually no retention was being provided, were slurried and pumped as in other years to the red mud tailings area.

Future work to be carried out at the site will include:

- provision of facilities to automatically change the rate of chemical addition in proportion to incoming flows and to equalize the changes in arsenic concentrations.
- improvement of the red mud tailings area for containment of sludge from the settling ponds.

## SAMPLING AND ANALYSIS

Routine sampling programs are carried out by the Industrial Wastes Branch and the Water Quality Branch. The latter monitors the arsenic concentrations throughout the watershed on a bimonthly basis while the former monitors the arsenic gaining access to the river at the plant site by sampling approximately bimonthly during winter and weekly during the remainder of the year.

The samples are submitted to the Ministry's laboratories in Toronto and are analysed by a modified Guitzeit method in accordance with the procedures described in "Standard Methods for the Examination of Water and Wastewater" 12th edition. Results are reported in milligrams per liter As and are accurate to two significant figures on concentrations greater than 0.10 and to one significant figure on concentrations less than 0.10. Arsenic determinations as low as 0.01 ppm can be made.

In this method all arsenic present in a sample is reduced to arsenite (+3 valence) by stannous chloride. In this form it reacts with hydrogen gas to produce arsine gas ( $\text{AsH}_3$ ) which reacts with silver diethyldithiocarbamate in pyridine to produce a colored solution (pinkis-orange) which is then measured colormetrically.

In Appendix I, the yearly average arsenic concentrations obtained at various locations throughout the Moira Watershed are tabulated.

In Appendix II, the yearly average arsenic concentrations above the plant site and at Highway #7 are shown graphically.

In Appendix III, the sample results from the upstream control point, Highway #7 and Moira Lake since January 1970 are tabulated.

An extensive compilation of the sample results obtained prior to 1970 can be found in the form of, "A Summary Report of Arsenic Levels Found In The Moira Watershed" prepared by the Industrial Wastes Branch in April 1970.

Because the frequency of sampling is much greater during the summer and fall periods, the sample results are first averaged monthly and then yearly. In this manner a more meaningful average is obtained.

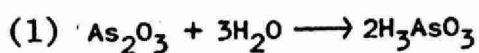
## DISCUSSION

### A - Arsenic Treatment Facilities

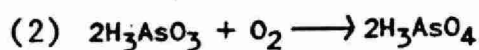
As the result of the work conducted at the site in the past two years, the characteristics of the arsenic bearing waters entering the treatment facilities have changed considerably with respect to lower volumes and much higher arsenic concentrations. These changes in waste characteristics made it necessary to install lime addition facilities in series with the existing ferrous sulphate addition facilities to maintain a neutral pH for the complete precipitation of the arsenic.

The chemistry of the existing treatment works, although not exactly known, is believed to proceed according to the following:

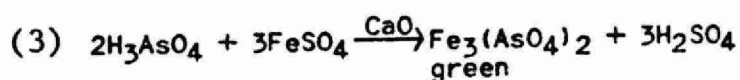
Upon contact with water, arsenious oxide is hydrated to produce arsenious acid which only slightly dissociates to give a weakly acidic solution. ✓



The arsenite ion (+3 valence) is readily oxidized to the arsenate form (+5 valence) by dissolved oxygen while still in the soil or while in transit to the treatment facilities.

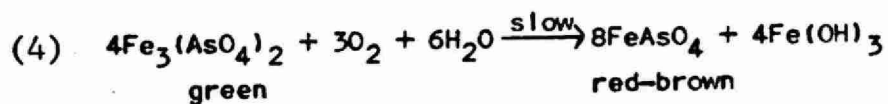


It is therefore presumed that most of the arsenic is in the oxidized state when the ferrous sulphate is added.



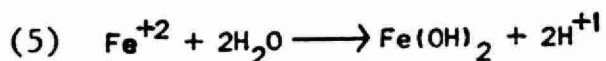
Upon discharge to the settling ponds two further reactions take place. They are:

the oxidation of the ferrous ion;



and,

the hydrolysis of the excess ferrous ion.



The addition of lime serves to neutralize the acid produced in equations 3 and 5 to maintain a neutral pH and permit

complete precipitation of the arsenic.

The following table outlines the characteristics of the wastes discharged to the treatment facilities prior to 1970 and at present.

	<u>PPM-As</u>			<u>Flow-GPM</u>			<u>Loading-lbs/day</u>		
	min.	max.	avg.	min.	max.	avg.	min.	max.	avg.
New Westerly Creek (Prior to 1970)	8	180	40	4	60	35	-	-	20
Present Facilities									
-Westerly collection system	110	650	320	17	63	40	20	400	184
-Clay dyke collection system	114	2350	780	1	25	4.6	15	110	52
Average Totals (present)			370			45	35	510	236

During 1972 the arsenic treatment facilities were operating at 78% efficiency, discharging an average of 52.4 pounds per day of arsenic to the river which represented 87% of the arsenic found in the river at Highway #7.

The following factors are believed to be contributing to the low removal efficiency:

- widely fluctuating flows and concentrations of wastes entering the treatment facilities, make adjustment of

chemical additions to correspond to arsenic loadings difficult

- solids build-up in the north settling pond did not permit complete settling in the latter part of the year causing carry over of precipitate.
- as the groundwater pumped from the clay dyke collection system is entering the chemical addition facilities near the outlet end, poor mixing prior to discharge to the settling basins may be occurring.

Better than 99% removal has been obtained in the past when arsenic loadings to the facilities have remained relatively constant. If 99% removal efficiency could have been maintained throughout 1972, the yearly average arsenic concentration at Highway #7 could have been expected to be within our objective of 0.05 ppm instead of 0.09 ppm as was experienced.

#### B - Arsenic Concentrations - Highway #7

The following table summarizes the average and maximum arsenic concentrations at Highway #7 for the past three years.

Arsenic as As - P.P.M.

	<u>Yearly Average</u>	<u>Maximum</u>
1970	0.31	1.70
1971	0.63	6.40
1972	0.09	0.30

The concentrations found in 1970 were more or less typical of the previous 3 years which had been relatively stable following the installation of the arsenic treatment facilities in 1966.

The unexpectedly high concentrations experienced in 1971 are believed to have been caused by the combination of:

- the disturbing of the sources of groundwater contamination while installing the clay dyke collection system increasing the rate of leaching, and
- unusually low river flows.

The low flows experienced in 1971 at Highway #7 were the lowest for a longer duration than had been recorded since the gauging station was established in 1965.

In 1972, the low concentrations experienced can be attributed to,

- the installation of the clay dyke collection system
- the sealing and underdraining of the poison pond area, and
- a relatively high flow during the low flow period.

The flows experienced in 1972 were at no time less than 20 times the low flow values of 1971.

Full assessment of the work completed to date by the company can only be made in a year where typically low flows prevail so that a basis of comparison can be established.

In order to explain the somewhat unpredictableness of the arsenic concentrations found in the river it is necessary to view the situation in hydrogeologic terms as the groundwater acts as a carrier in the transmission of arsenic from the site to the river.

Basically stream runoff may be separated into 3 components. These are direct runoff which flows over the land surface; interflow which consists of water that flows part of the way underground but does not become part of the main groundwater body; and base flow which is natural groundwater discharge. Direct runoff occurs only during and immediately after periods of rain; interflow generally continues somewhat longer, but during extended periods of dry weather stream flow is maintained solely by groundwater discharge.

Upstream of Deloro, the 3 stream flow components, can be regarded as essentially uncontaminated and as such, dilution, for the arsenic bearing groundwater gaining access to the river at the plant site.

During prolonged dry periods in late summer and early fall

direct runoff and interflow are essentially nonexistent, and since these comprise the major portion of the stream flow, the dilution afforded is greatly reduced resulting in high arsenic concentrations in the river. Although this would adequately explain the general trend of arsenic concentrations throughout the year, there are numerous deviations from the expected values which cannot be attributed to fluctuations in streamflow. Other factors which could cause the concentrations in the river to be higher or lower than expected are (1) fluctuating groundwater flows and arsenic concentrations and (2) localized precipitation.

#### C - Arsenic Concentrations - Moira Lake

The main concern of arsenic contamination in the Moira River watershed is in Moira Lake which is heavily used for recreational purposes and is a source of drinking water during the summer for some of the surrounding cottages.

The yearly average and maximum arsenic concentrations in Moira Lake for the past five years is tabulated below:

	<u>Arsenic as As</u>	
	<u>Yearly Average</u>	<u>Maximum</u>
1968	0.10	0.26
1969	0.13	0.36
1970	0.09	0.24
1971	0.08	0.15
1972	0.06	0.11

In 1971 the Ontario Department of Health released suggested drinking water quality objectives for arsenic in the Moira River watershed. Water was deemed safe for drinking on a continuous usage basis at an average concentration of 0.05 ppm with the maximum concentration not exceeding 0.15 ppm and on a short term basis of up to 6 weeks at a concentration of 0.20 ppm.

Under these objectives, Moira Lake can be regarded as an acceptable source of drinking water for use by cottagers and marginally acceptable for continuous use. It is believed that no one used the water continuously for drinking purposes.

A literature review indicates that the arsenic concentrations in Moira Lake are well below levels that could cause symptoms of arsenic poisoning.

It is believed that the further upgrading of the treatment facilities to be carried out in the spring of 1973 will result in a subsequent lowering of the average arsenic concentration at Moira Lake to within the Ministry's objective.

#### CONCLUSIONS AND RECOMMENDATIONS

The south settling pond effluent was by far the major source (87%) of contamination at Highway #7 in 1972. In spite of the low removal efficiency of the treatment facilities - 78%, the 1972 average concentration of 0.09 ppm was the lowest value recorded since the

problem was detected in 1957. It would therefore, appear that the works installed in 1970 and 1971 have been quite effective in collecting and treating the major sources of contaminated groundwater.

It is believed that the treatment facilities can be upgraded before the summer of 1973 to maintain a 99% removal efficiency. With this improvement the arsenic loading at Highway #7 would be greatly reduced and the yearly average arsenic concentration would expect to be maintained within the Ministry's objective of 0.05 ppm.

In August 1972 the company was requested to improve the efficiency of the treatment facilities. It was suggested to the company that this could possibly be done by discharging all waste streams to an equalization basin and pumping at a constant rate from the basin to the chemical addition facilities with the pump and chemical feeders being automatically turned on and off by a level control in the equalization basin.

The company retained James F. MacLaren Limited, Consulting Engineers, to investigate alternative methods of improving the removal efficiency. The Ministry was verbally informed that the equalization basin and pumps as suggested in August 1972 would be installed. To date installation of these works has not been started. It is recommended that these facilities be completed and placed in operation at the earliest possible date.

The capacity of the red mud tailings area at present is not sufficient to properly contain the solids pumped from the waste treatment settling basins. It is therefore recommended that a suitable site be developed for the retention of the solids that accumulate in the settling basins. Capacity for these solids could possibly be provided by raising the height of the tailings dam in the red mud tailings area.

Investigations to locate other possible sources of arsenic will continue and if detected the company will be requested to take immediate remedial action.

To date alleviatory action has been directed towards an immediate solution of the problem, whereas, a long term solution has not been seriously considered. It is estimated that the company will spend in the order of \$30,000 annually to operate the arsenic treatment facilities. It is thought that the quantity of soluble arsenic that remains to be treated would make long term treatment in this manner highly expensive.

In an effort to eliminate the expense of long term operation of the existing treatment facilities it is suggested that the company investigate methods by which the arsenic may be treated in place on a one time basis.

Methods by which this might be accomplished could possibly

take the form of the following:

- permanently sealing all the sources of groundwater contamination to prevent further leaching
- permanently treating all the sources of groundwater contamination in the ground
- controlled or induced leaching of the sources of groundwater contamination.

The cost of short term treatment may be less than the long term approach now being utilized.

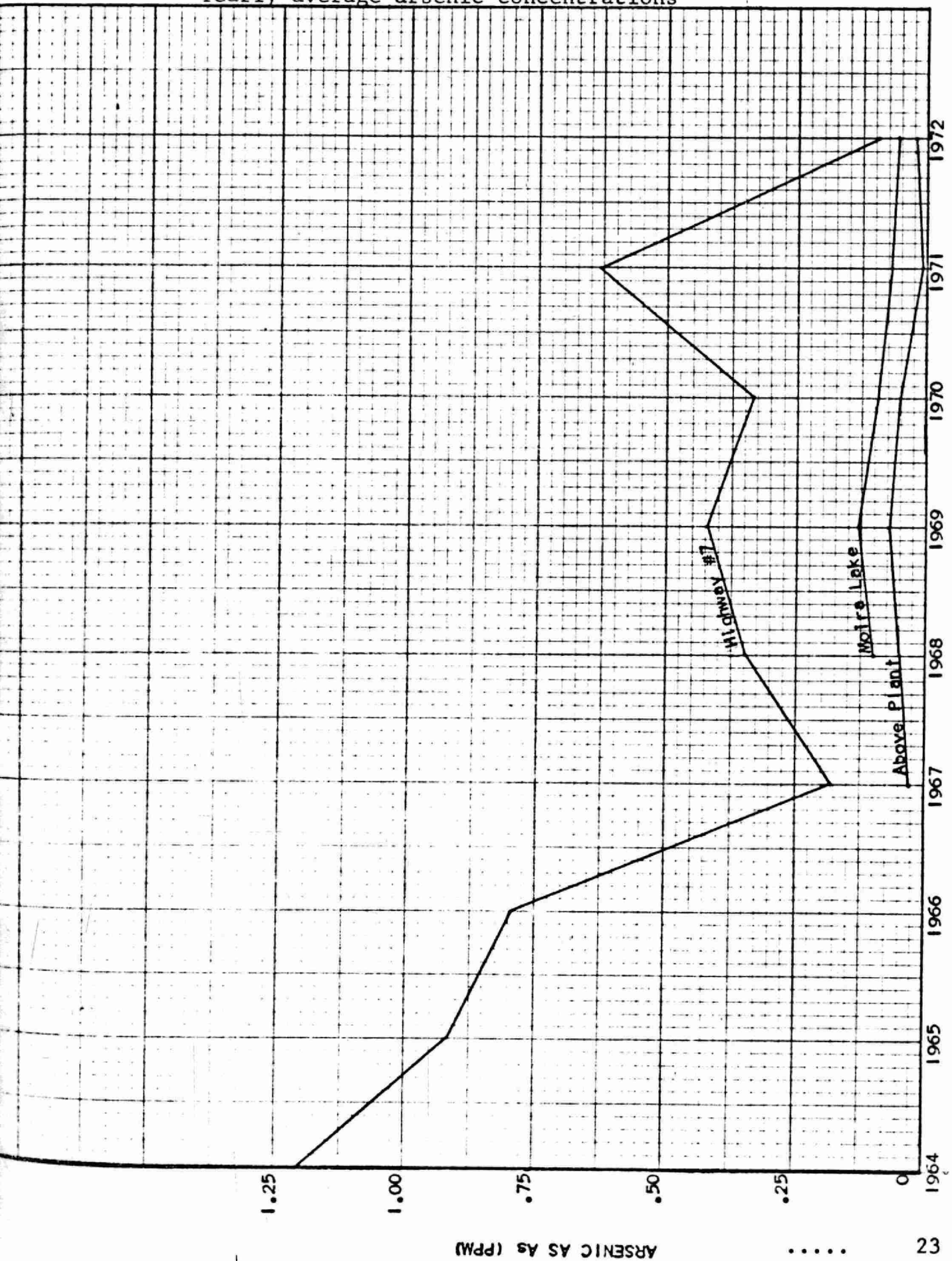
APPENDIX I

Summary of the yearly average arsenic concentrations at various locations throughout the Moira Watershed.

ARSENIC AS  $P_2O_5$  M.

Moira River Stream Mileage	1966	1967	1968	1969	1970	1971	1972
Highway #2	-	-	.01	.03	-	.03	.02
Cannifton Bridge	-	-	.01	.03	.04	.03	.02
Stoco Lake Outlet	-	.01	.01	.04	.08	.03	.02
Stoco Lake	-	.01	.02	.04	.05	.03	.02
Stoco Lake	-	-	-	.04	.04	.03	-
Tweed	-	-	.01	.03	.03	.03	.02
Moira Lake	-	-	.10	.13	.09	.07	.06
Highway #7	.79	.18	.34	.42	.33	.63	.09
Above Site	.17	.03	.05	.07	.05	.01	.02

APPENDIX II  
Yearly average arsenic concentrations



### APPENDIX III

#### ARSENIC ANALYSIS RESULTS OF SAMPLES OBTAINED

- UPSTREAM OF PLANT SITE
- HIGHWAY #7
- MOIRA LAKE

SINCE JANUARY 1970

Arsenic as As (ppm)

1970

DATE	ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
Jan. 11	.02	.12	
Feb. 22	.03	.11	
Feb. 23	.02	.12	
Apr. 19	.00	.03	
Apr. 22	.00	.04	.05
May 4		.00	.03
May 10	.01	.05	
May 19		.05	
May 20	.02	.08	
May 21	.02	.08	
May 28	.02	.05	
June 2		.07	.08
June 9		.12	
June 14	.02	.18	
June 17	.01	.36	
June 17		.22	.01
July 6	0.1	.20	
July 6		.16	.10
July 12	.03	.17	
July 16	.01	.20	
July 16		.16	.11

.....

970

Arsenic as As (ppm)

DATE	ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
July 22	.09	.35	
July 28	.03	.29	
Aug. 2		.35	
Aug. 4		.28	.17
Aug. 9	.03	.26	
Aug. 13	.01	.49	
Aug. 14		.45	
Aug. 18	.01	.63	.12
Aug. 20	.01	.77	
Aug. 24		.85	
Aug. 26	.11	.98	
pt. 1		.61	.09
pt. 2	.03	.71	
pt. 4	.03	.92	
pt. 11		.75	
pt. 13	.24	.96	
pt. 15	.23	.91	
pt. 23	.04	.90	
pt. 23		1.24	.24
pt. 29		1.39	
pt. 5		.95	
pt. 8		.86	.13
pt. 11		.63	

.....

1970		<u>Arsenic as As (ppm)</u>		
DATE		ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
Oct.	13		.35	.10
Oct.	16		1.20	
Oct.	23		1.70	
Nov.	3	.05	.27	.04
Nov.	6			.09
Nov.	10		.28	.01
Nov.	13	.01	.21	.12
Nov.	17	.04	.27	
Nov.	24	.03	.28	
Dec.	2	.01	.12	
Dec.	9	.01	.14	
Dec.	10	.01	.18	
Dec.	16		.13	

.....

Arsenic as As (ppm)

1971

DATE	ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
Jan. 13	.04	.10	.10
Jan. 26		.08	
Feb. 12		.05	
Mar. 10	.01	.12	.07
Mar. 17		.23	
Mar. 26		.15	
Mar. 30	.02	.24	.02
Apr. 2		.33	
Apr. 18		.44	
Apr. 19		.06	
Apr. 20		.04	
Apr. 27	.02	.05	.01
May 3		.03	.05
May 4	.03	.02	
May 12		.06	
May 27	.00	.08	.05
May 31	.01	.09	
June 9	.01	.21	
June 17		.25	
June 22		.56	
June 23	.02	.04	.10

.....

971

Arsenic as As (ppm)

DATE		ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
June	30		.30	
July	1		.03	
July	17		.64	
July	21		.65	
July	22	.00	.64	.10
July	28		.94	
July	30		.70	
Aug.	5		.90	
Aug.	18		1.50	
Aug.	18	.03	.70	.15
Aug.	20		1.5	
Aug.	27	.03	1.8	
Sept.	1		1.8	
Sept.	6		2.9	
Sept.	7		2.8	
Sept.	9		2.7	
Sept.	14		2.8	
Sept.	15		4.4	
Sept.	17		5.7	
Sept.	22		6.4	
Sept.	28	.01	2.50	<.01
Oct.	18		.78	
Oct.	27	<.01	.79	.15

.....

Arsenic as As (ppm)

	ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
8		.45	
22	.02	.07	
25	< .01	.84	
2	.02	.14	< .01

Arsenic as As (ppm)

1972

DATE		ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
Jan.	6	.03	0.10	.10
Jan.	13		0.07	.09
Feb.	2	.02	0.07	.08
Feb.	14		.05	.06
Feb.	29	.01	.05	.04
Mar.	6		.05	
Mar.	8		.06	
Mar.	28	.01	.06	.03
Apr.	3		.23	
Apr.	11		.17	.06
Apr.	24		.02	
Apr.	26	< .01	.03	.03
Apr.	28		.02	
May	5	< .01	< .01	
May	16	.12	.12	
May	25	.04	.04	.07
May	30	.01	.10	.01
June	8	.08	.08	.07
June	12	< .01	.04	
June	15		.05	.07
June	16	< .01	.06	

.....

1972

Arsenic as As (ppm)

DATE	ABOVE PLANT SITE	HIGHWAY #7	MOIRA LAKE
June 22			.07
June 26		.04	.07
June 27	< .01	.04	.07
June 28	.03	.05	
July 5	.04	.07	
July 18	.04	.30	.10
July 25			.07
July 26	.05	.13	
July 29			.06
Aug. 3	.03	.16	
Aug. 6			.08
Aug. 8		.22	.14
Aug. 10	< .01	.18	.10
Aug. 18		.10	
Aug. 22		.12	
Sept. 6	.01	.02	< .01
Sept. 14	.03	.15	
Sept. 28	.03	.18	
Oct. 5	.02	.10	.08
Oct. 10	< .01	.07	.06
Oct. 25	.04	.10	
Oct. 30	< .01	.02	
Nov. 1	< .01	.03	.03
Nov. 7	< .01	.06	
Nov. 15	.04	.18	
Nov. 24		.04	

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